MICHIGAN ENVIRONMENTAL SCIENCE BOARD

LOW LEVEL RADIOACTIVE WASTE PANEL
MEETING SUMMARY
WEDNESDAY, OCTOBER 25, 1995
PARK INN INTERNATIONAL
HOWELL, MICHIGAN

PANEL MEMBERS PRESENT
Dr. Lawrence Fischer, Chair
Mr. James Carey
Dr. David Long
Dr. David Morrissey
Dr. Conrad Nagle
Dr. Bette Premo
Mr. Keith Harrison, Executive Director

DMB\EAD SUPPORT STAFF PRESENT
Mr. Jesse Harrold, Environmental Officer
Ms. Patricia Hiner, Secretary

I. CALL TO ORDER

Dr. Lawrence Fischer, Chair, called the meeting of the Low Level Radioactive Waste Panel to order at 1:00 p.m. Mr. Harrison made a brief report on several administrative matters.

II PUBLIC COMMENT

Dr. Fischer opened the meeting to public comment and encouraged anyone wishing to speak to also provide the Panel with a written copy of their comments. There was no public comment.

III. PRESENTATIONS

Mr. Thor Strong, Associate Commissioner for the Michigan Low-Level Radioactive Waste (LLRW) Authority, presented a three dimensional model of a LLRW facility to the Panel. The model was constructed in the late 1980s and was purchased from Illinois when that state was considering it as one of several possible LLRW facility designs. Mr. Strong indicated that the purpose of the model was to convey to the Panel the concept that any design which Michigan might consider would need to be an engineered site rather than a landfill. The particular model shown by Mr. Strong was a vault structure made up of several modular containers built of concrete. Most of the structure would be above ground and covered with both natural and synthetic liners to prevent infiltration.

Monitoring systems would be installed around the vaults to intercept and collect any moisture that could potentially leak in.

Michigan has not yet decided on any specific facility design, but by state law is bound to consider two basic designs, one a vault structure, and one an earth-mounded concrete bunker system. Both designs would provide multiple engineered barriers between the waste and the outside environment.

There are currently only two facilities in operation in the U.S. (Barnwell facility in South Carolina and U.S. Ecology facility in Hanford, Washington). Neither facility is engineered. The Barnwell facility is a shallow end burial system, composed of clay-lined trenches with a leach collection system. The U.S. Ecology facility consists of pits in the soil.

Dr. Premo asked if the LLRW model represented state-of-the-art in terms of design. Mr. Strong indicated that it did not. State-of-the-art would entail the incorporation of multiple layers of waste-isolating layers of both natural and synthetic materials, the capability of ensuring the retrievability of the waste should some problem occur, and the incorporation of a monitoring system capable of quickly alerting operators of problems. Mr. Strong indicated that he would provide the Panel with contacts and information for the two state-of-the-art facilities currently being used or built in France and England.

Dr. Morrissey asked if information could be provided to the Panel on the estimated facility volume, lifetime costs, and per unit costs of the LLRW model. Mr. Strong indicated that he could provide this information also.

Mr. Mark Thaggard, U.S. Nuclear Regulatory Commission (USNRC), provided the Panel with background information on the USNRC's low-level waste performance assessment criteria and siting requirements. A summary of his presentation and a copy of his overheads are provided in Attachment 1.

Dr. Fischer asked if the 500 year value represented the time frame when the level of radioactivity would be at background. Mr. Thaggard explained that 500 year value represents the time frame when the level of radiation of the material contained in the facility should be such that an intruder would not encounter an exposure dose of greater than 500 millirems. The performance standard of 25-75-25 millirems does not have to be met indefinitely, therefore, the performance standard would be applicable to the public and the 500 millirem value would applicable to the intruder. Dr. Long commented that if long life nuclides are present, the 25-75-25 millirems requirement must be met anyway.

Mr. Carey stressed the importance of understanding the 500 year criteria, stating that it could not represent a background level because there are low-level wastes, for instance, being produced at the University of Michigan, which would be stored at such a facility that have an half life of 5,000 years. Dr. Morrissey indicated that most Class C wastes, which are the worst, decay to a level which would not pose a hazard after 500

years. The other nuclides, like Carbon 14 and the uraniums do not fit into the 500 year category, except in the sense of radiation. Drs. Nagle and Premo added that the majority of the LLRW was Class A, including much of what is received from power plants.

Dr. Theodore Bornhorst (Michigan Technological University) provided the Panel with a brief historical background on the development of the state siting criteria contained in PA 204 of 1987. A summary of his presentation is contained in Attachment 2.

Dr. Premo asked Dr. Bornhorst to clarify the different positions contained in the Board of Governor's 1995 report on LLRW. Dr. Bornhorst indicated that there was a majority opinion that: (1) the current state siting criteria should be removed and the state should fall under the federal criteria and (2) individual volunteer host communities could designate further, more stringent criteria should they so desire. The minority position held that the state criteria should be kept and then allow a waiver process for specific criterion based on its being shown that such action would not jeopardize public health.

Dr. Nagle asked if the state siting criteria committee looked at other states when it conducted its evaluation of the criteria contained in PA 204 of 1987. Dr. Bornhorst indicated that it did; however, the information was used primarily as background rather than as a tool to compare how well Michigan's law stacked up to other states in terms of levels of public and environmental health protection provided.

Dr. Long asked if the role of microbial processes and mobility is or has been addressed in the state siting or federal performance criteria. Dr. Bornhorst stated that the issue was not directly addressed in either, however, the federal performance criteria do outline the degree to which the site should operate and, therefore, would take microbial activity into account.

Dr. Morrissey expressed concern about the potential open-endedness of performance criteria. Dr. Bornhorst agreed, stating that some of the performance criteria should have some outer limit set within which performance would need to be demonstrated by an applicant.

IV. DISCUSSION

Dr. Premo expressed concern that if the Panel supports the performance assessment technique, it will not be able to answer directive three (to determine if the facility can be located in Michigan), without knowing the results of the National Academy of Sciences studies. She asked if a low level isolation facility could be located in Michigan without posing dangerous levels of radioactive risk to public health, safety, and environment. Mr. Carey responded that if a facility is built that will result in less than 25 millirems, the risk would be minimal. The question remains as to whether a facility can be built that will meet the federal performance criteria.

Mr. Strong added that if the siting process proceeds, the performance assessment and performance-based risk assessment are not options, they would be required in order to license the facility through the USNRC. The real question is whether Michigan's siting criteria add any measurable levels of safety to the environment or to the public beyond what would be assured if a site was found that met the performance objectives. Dr. Nagle suggested that they probably did provide additional safety, but questioned their necessity. He suggested that the Panel inquire as to whether other states found it necessary to create their own criteria in addition to the federal standards.

Dr. Nagle stated that many of the state siting criteria are reasonable and conform to federal guidelines. However, he raised concern over the siting criteria used in the performance assessment, suggesting a possible influence from the political process. The state criteria, as originally enacted, are in part arbitrary and lack sufficient scientific basis. Dr. Fischer added his concern over the uncertainties assocated with the use of performance standards.

Mr. Strong stated that while the federal siting requirements are performance oriented, they are fairly general. Michigan criteria model these fairly well. Except for the ones which deal with flood plains and wetlands, there are not many that can be use to categorically eliminate land area in Michigan.

Dr. Long directed the conversation to the relative risk section of the Governor's charge, which requests the Panel to compare the relative risk of a LLRW site to risks associated with x-rays, radon, etc. Dr. Morrissey commented that when reviewing the literature, the risk associated with a 25 millirems per year is relatively low. In addition, there are data available which may be used to address that question.

Dr. Morrissey suggested hearing from someone, possibly from Illinois, California or Texas, who is currently building a LLRW facility and is intimately involved in USNRC performance assessment process;. Mr. Strong and Dr. Nagle suggested contacting Khem Nuclear and US. Ecology.

Drs. Fischer and Premo suggested that it might be useful to have someone present information concerning the USNRC siting criteria and regulations. Mr. David Menard, Michigan Department of Public Health, added that basic definitions, impact on Michigan law, radioactive wastes not included in the compact, and current wastes entering the waste stream might also be useful topics for the Panel.

V. NEXT MEETING DATE

No date was set for the next meeting of the Panel. Mr. Harrison indicated that his office would poll the Panel members on the best date for everyone.

VI. ADJOURNMENT

The meeting was adjourned at 4:20 p.m.

Keith G. Harrison, M.A., R.S., Cert. Ecol.
Executive Director
Michigan Environmental Science Board

ATTACHMENT 1. Summary of Presentation and Copy of Overheads used by Mr. Mark Thaggard, U.S. Nuclear Regulatory Commission.

Mr. Thaggard indicated that there are four performance objectives for waste facilities in the U.S. Nuclear Regulatory Commission (USNRC) regulations, (1) protection of the general public from the release of radioactive materials, (2) protection for the inadvertent intruder; (3) protection for operators; and (4) long term stability of the site. Only the first objective, protection of the general public, must be demonstrated by the applicant. Radioactive releases must not result in annual doses exceeding 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ. One USNRC provision, referred to as "As Low As Reasonably Possible" (LARA), requires that even if a release meets the numerical standards, if there are other measures that can be taken to reduce the release levels, those measures should be taken. These figures have not changed over the years, but the USNRC is considering a regulation change to convert them to a 15 millirem total effective dose standard; a standard used in another part of the regulations. The USNCR's standard differs from the requirement of the federal Clean Air Act and USEPA regulations, which is 10 millirems, but the USEPA and USNRC have an agreement that as long as the USNRC's standard can be met, a licensee does not have to prove compliance with the USEPA standard.

The low-level waste performance assessment is a technical analysis used to demonstrate that the performance objective (annual dose not exceeding 25-75-25 millirems) can be met after the closure of a facility, when there is no monitoring being done and operations standards are no longer in effect. The assumption is that once closed, a site will remain stable. The analysis must demonstrate clearly that the exposure to humans will not exceed the performance objective. There is a different set of rules for the time facilities are actually in operation.

The regulations do not require any particular approach, however, there are several pathways which need to be analyzed by the applicant, including air, water, soil, groundwater, surface water, plant uptake, and exhumation by animals. The analysis must demonstrate reasonable assurance that exposure to humans will not exceed the performance objective. The goal of the analysis is to identify key model assumptions and parameters, develop a defensible technical basis for conclusions, and reach defensible regulatory decisions. The analysis itself should be comprehensive and quantitative, rather than qualitative; incorporate site characterization and design, incorporate a formal treatment of uncertainty, and be completely documented. The analysis should also be a multi-disciplinary effort, and capable of being repeated with new data and assumptions as necessary. The USNRC model begins with an evaluation of existing data about the site, engineering design, waste characterization, etc., from which an initial conceptual model and parameter distributions can be developed. Parameter distributions try to capture the uncertainty existing in a particular parameter. The conceptual models and parameter distributions should lead to formulation of a mathematical model, then computer model, which will ultimately give a dose distribution that incorporates uncertainty. It is especially important that a sensitivity analysis be performed. That analysis will identify parameters

and assumptions that may have the biggest effect on the dose. If, after this process, a licensee can meet the performance standard, the application can be submitted to the regulatory agency. If not, the process can be redone with better data and different assumptions, or a new conceptual model. The advantage of this method is that the performance assessment can drive the data collection and minimize wasted effort.

The model includes sub-analyses on infiltration, engineered barrier performance, environmental transport, and dose modeling. In each sub-zero, data are plugged into the mathematical model, then the entire model is run together. The analysis to estimate the release of contaminants from the disposal unit is called the source term analysis. After that is determined, transport of the released contaminants through the outside environment is analyzed, and finally concentrations that may reach humans are converted into doses that are compared to the standard. The assessment is performed by the potential licensee, but is validated by the regulator.

[OVERHEAD USED BY MARK THAGGAR (Pages 8 - 19 of Meeting Summary)]

Low-Level Radioactive Waste Performance Assessment

Presentation to

Michigan Environmental Science Board
Low-Level Radioactive Waste Panel

GRAPHIC OF NRC LOGO
(Would not scan)

Mark Thaggard, Hydrologist
Division of Waste Management
(301)415-6718, MXT3@NRC.GOV

OCTOBER 25,1995
Howell, Michigan

10 CFR 61.41 PERFORMANCE OBJECTIVE

Protection of the General Population from Releases of Radioactivity

"Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants or animals must not result in an annual dose exceeding an equivalent of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluent to the general environment as low as is reasonably achievable."

DEFINITION OF LLW PERFORMANCE ASSESSMENT

Performance Assessment is the Technical Analyses used to Demonstrate Compliance with the 10 CFR 61.41 Performance Objective:

- **"Pathways analyzed...must include air, soil, ground water, surface water, plant uptake, and exhumation by burrowing animals"**

- **Analysis must clearly demonstrate reasonable assurance that the exposure to humans from the release of radioactivity will not exceed the limits set forth in Section 61.41**

PA concerned with analyses of long-term performance (post-closure)

Operations (Section 61.43) and stability (Section 61.44) addressed separately in license application

Intruder analyses (Section 61.42) generally not covered within PA

LLW PERFORMANCE ASSESSMENT PROCESS

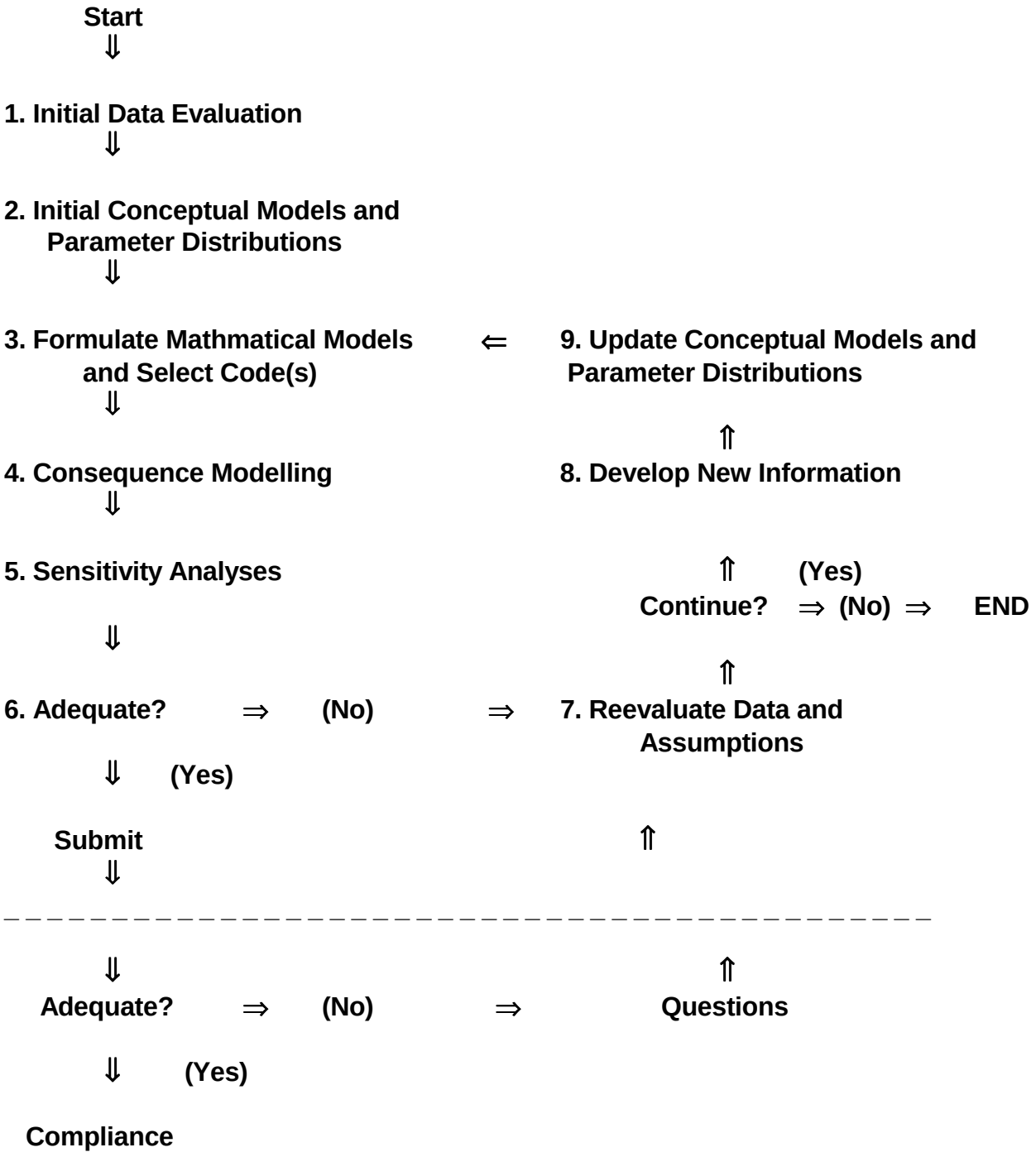
Attributes and Goals

Attributes:

- **Iterative process**
- **Comprehensive and quantitative to extent practicable**
- **Integrates site characterization and design with PA**
- **Incorporates a formal treatment of uncertainty**
- **Procedure for documenting process**
- **Provides a process for decision making**

Goals:

- **Identiy key model assumptions parameters**
- **Develop credible and defensible technical basis**
- **Reach defensible regulatory decisions**


Start
1. Initial Data Evaluation
2. Initial Conceptual Models and Parameter Distributions
3. Formulate Mathmatical Models and Select Code(s)
4. Consequence Modelling
5. Sensitivity Analyses
6. Adequate?
(No)
(Yes)
7. Reevaluate Data and Assumptions
8. Develop New Information
9. Update Conceptual Models and Parameter Distributions
Continue?
(Yes)
(No)
END
Submit
Adequate?
(No)
Questions
(Yes)
Compliance

PERFORMANCE ASSESSMENT METHODOLOGY

Sub-System Areas

Infiltration

Engineered barriers performance

Source term

Environmental transport
- **Ground water**
- **Surface water**
- **Air**

Dose

GRAPHIC
(Would not Scan)

(Graphic depicts how precipitation, via infiltration - percolation though the disposal unit, could result in human exposure)

NRC SITING REQUIREMENTS

Presentation to

Michigan Environmental Science Board
Low-Level Radioactive Waste Panel

GRAPHIC OF NRC LOGO
(Would not scan)

Mark Thaggard, Hydrologist
Division of Waste Management
(301) 415-6718, MXT3@NRC.GOV

OCTOBER 25,1995
Howell, Michigan

10 CFR 61.50(a) SITING REQUIREMENTS

Are designed to help ensure that the dose objectives will be met

Are minimum technical requirements

> **Additional requirements may be specified, especially to ensure environmental protection**

Are intended to provide long-term isolation of the waste

Are for near-surfacedisposal

SPECIFIC SITING REQUIREMENTS

The site must be capable of being characterized, modeled, analyzed and monitored

The site should be located away from existing and projected populated areas

The site should not contain natural resources which, if exploited, would result in failure to meet the performance objectives

The site should be well drained and free of areas of flooding or frequent ponding

The upstream drainage area of the site must be minimized to minimize runoff

The site must provide sufficient depth to the water table that groundwater intrusion into the waste will not occur

SPECIFIC SITING REQUIREMENTS (CONT.)

The hydrogeologic unit used for disposal must not discharge to the surface within the site

The site must not be located in an area where tectonic processes or vulcanism could affect the ability of the site to meet the performance objectives

The site must not be located where surface geologic processes could affect the ability of the site to meet the performance objectives

The site must not be located where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives

SOURCES OF ADDITIONAL INFORMATION

SITE SELECTION:

Regulatory Guide 4.18

Regulatory Guide 4.19

NUREG-O902

SITE CHARACTERIZATION:

Regulatory Guide 4.18

NUREG-O902

NUREG-1199

NU REG/CR-2700

NUREG/CR-3l64

ATTACHMENT 2. Presentation (via speakerphone) by Dr. Theodore Bornhorst, Michigan Technological University.

Dr. Bornhorst began his presentation by stating that his first involvement in looking at radioactive waste in Michigan was when he served on Governor Blanchard's Task Force on High Level Radioactive Waste. This task force was created when the U.S. Department of Energy was looking at Michigan as a possible recipient of high level radioactive waste. Subsequent to that, he served on the Radioactive Waste Control Committee, which was the precursor to the Low-Level Radioactive Waste (LLRW) Authority. Under the LLRW Authority, he served on the Siting Criteria Advisory Committee which was responsible for reviewing the state siting criteria contained in PA 204 of 1987.

The Siting Criteria Advisory Committee was not requested by the administration to determine if the criteria in PA 204 of 1987 were justifiable or not. Rather, it was charged to evaluate three concerns: (1) will the criteria protect the public health and safety of Michigan citizens; (2) will the criteria avoid conflict with established social and community values; and (3) will the criteria comply with federal and other state regulations. The Committee was told that it should not make any effort to change PA 204 of 1987. Rather the role of the Committee would be to attempt to make the law more consistent and to enhance it.

Dr. Bornhorst indicated that several of the numerical criteria appear subjective; e.g., ten miles from a Great Lake shoreline. The feeling on the part of some of the Committee was that performance criteria would be better than subjective numerical limits. Dr. Bornhorst stated that he felt that the performance criteria and the site characteristics should be used together to set parameter limits or site specific numerical limits. It appears that there is no other performance criteria guide available that is more appropriate for LLRW facility siting than the USNRC guidelines. The theoretical assumption that in 500 years a repository's radioactive level would have decayed to background levels seems reasonable with respect to the types of wastes the facility would receive. Also if the economic cost of extra safety precautions are reasonable, they should be considered in the facility siting and construction.

Dr. Bornhorst commented on the following criteria as they appeared in the state siting law (PA 204 of 1987).

Objective I, Criterion A, *Exclude areas within incorporated city limits as established on January 1,1988.* If there is a good site inside a corporate limit it should be considered. The city limit line does not necessarily dictate a high human population nearby.

Objective I, Criterion B, *Exclude areas not sufficiently large to assure that an isolation distance of 3,000 feet (915m) or more from the disposal unit and adjacent property lines is available.* The 3,000 feet from an adjacent property line criterion is an arbitrary number and unjustified.

Objective I, *Criterion C, Seek areas where projected population growth and future developments are not likely to affect the ability of a disposal facility to meet the performance objectives of 10 CFR 61 Subpart C (10 CFR 61.50 (a)(b) and are not likely to significantly interfere with an environmental monitoring program.* Avoiding populated areas is a speculation based on probabilities, which is likely reasonable and is found in 10 CFR 61.

Objective II, Criterion A, *Exclude areas located one mile or less from a fault where tectonic movement has occurred within the last 10,000 years.* One mile is an arbitrary distance.

Objective II, Criterion B, *Exclude areas of significant earth intensity, defined as zones with a modified Mercalli index of VII or greater.* Earthquake intensity should be considered and used in the criteria.

Objective II, Criterion C, *Exclude areas within the 500 year flood plain, including areas designated under 245 PA 1929 (Sections 323.1 to 323.13 of the Michigan Compiled Laws).* The 500 year flood plain criterion is somewhat arbitrary but is reasonable when considering the life of the facility to be 500 years. The assigned buffer zone around the facility should not be considered part of the facility.

Objective II, Criterion D, *Exclude areas where geological processes such as mass wasting, erosion, slumping, land-sliding or weathering precludes meeting the performance objectives in 10 CFR 61 Subpart C or precludes defensible modeling and prediction of the long term impact of such occurrences.* This is redundant of federal regulations .

Objective III, Criterion A, *Exclude areas where the water table associated with geologic deposits or formations is not sufficiently low to prevent the intrusion of groundwater into the disposal unit or bottom most portions of the leak detection system, if one should be included in the design.* This is a reasonable criterion.

Objective III, Criterion B, *Exclude areas where there is not 6 or more meters (20 feet) of soil with a maximum hydraulic conductivity of 1.0 times to the minus 6 centimeters per second at all points below and lateral to the disposal unit and bottom most portions of the leak detection system, if one should be included in the design, or areas where there is not greater than 6 meters of relatively impervious soil that provides equivalent environmental protection to the public health, safety, welfare, and the environment. This soil should extend laterally a sufficient distance to assure that it cannot be circumvented by ground water flow within 500 years*. This criterion is reasonable.

Objective III, Criterion C, *Exclude areas where the average travel time of groundwater along any 100 foot flow path from the water table beneath the bottom of the disposal unit is less than approximately 100 years.* The 100 years criterion is arbitrary and not

consistent with the 500 year life expectancy of the facility.

Objective III, Criterion D, *Exclude areas where the average groundwater travel time from the water table beneath the bottom of the disposal unit to an aquifer is less than 500 years.* This criterion is consistent with the 500 year decay rate assumed for the LLRW facility.

Objective III, Criterion E, *Exclude areas located over a designated sole source aquifer.* Not locating a LLRW site over a known aquifer designated a sole source is reasonable.

Objective III, Criterion F, *Exclude areas located where the hydrogeology beneath the site discharges groundwater to the surface within 3;000 feet (915 m) of the boundaries of the disposal unit.* The 3,000 foot criterion is arbitrary.

Objective III, Criterion G, *Exclude areas not free of ponding or incapable of being drained in a manner that ensures the integrity of the disposal unit*. This is reasonable.

Objective III, Criterion H, *Exclude areas located within 10 miles of Lake Michigan, Lake Superior, Lake Huron, Lake Erie, Saint Mary's River, St. Clair River or Lake St. Clair. This criterion shall not apply to a site that is located at or adjacent to a nuclear power generating facility.* Ten is an arbitrary number.

Objective III, Criterion I, *Seek areas with simple hydrologic systems that can be characterized, modeled, analyzed and monitored.* The capability to monitor the hydrological system near the site is consistent with 10 CFR 61.

Objective III, Criterion J, *Seek areas that do not overlie aquifers that produce potable water.* This is very difficult to achieve in Michigan and is unreasonable.

Objective III, Criterion K, *Seek areas which do not include public water supply wells, well fields, high capacity production wells, and abandoned wells.* This is reasonable.

Objective III, Criterion L, *Exclude areas located where the hydrogeology beneath the site discharges groundwater to the land within 3,000 feet of the boundaries of the candidate site*. The 3,000 foot criterion is arbitrary.

Objective III, Criterion M, *Exclude areas located above an aquifer that is the primary source of drinking water for a municipality or for persons residing or doing business in the municipality or county where a candidate site is located.* This criterion does not consider the location of the aquifer or the origin of its water.

Objective IV, Criterion A*, Seek areas which minimize the risk of transportation accidents.* This criterion is reasonable.

Objective IV, Criterion B, *Seek areas which minimize the risk of exposure to radiation*

associated with transportation accidents. This criterion is reasonable.

Objective V, Criterion A, *Seek areas with simple meteorological systems that can be characterized, modeled, analyzed, and monitored.* This criterion will enhance air monitoring and is reasonable.

The criteria found in the remaining Objectives (Objectives VI through IX) of PA 204 of 1987 are inclusive of the intent of other laws and other interest. These objectives were designed to avoid conflicts with natural resource development, wetlands, environmentally sensitive or special areas, visual intrusion, good farmland, and lands with proposed or approved development plans, and give preference to any community which desires a facility. All of the above criteria are reasonable.